A Work Project, presented as part of the requirements for the Award of a Master Degree in Management from the NOVA – School of Business and Economics.

STATE-OF-ART OF ARTIFICIAL INTELLIGENCE

IN THE PORTUGUESE FOOD RETAIL SECTOR

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22-05-2020

Abstract

This study aims to explore the actual state of the art of the use of Artificial Intelligence (AI) in the food retail industry in Portugal. Literature review is conducted to propose industry definitions and to provide insights regarding the competitive landscape and AI adoption in industries. Three research questions are answered regarding technology and AI in food retailing. Qualitative research concluded that retailers consider technology an enabler for the future of their businesses and physical stores. Although knowing what AI is, they still consider to be beginners and mainly find it useful for the optimization of their operations.

Key Words: Food Retail, Retailers, Technology, Artificial Intelligence (AI), Customer Experience, Operations.

This work used infrastructure and resources funded by Fundação para a Ciência e a Tecnologia (UID/ECO/00124/2013, UID/ECO/00124/2019 and Social Sciences DataLab, Project 22209), POR Lisboa (LISBOA-01-0145-FEDER-007722 and Social Sciences DataLab, Project 22209) and POR Norte (Social Sciences DataLab, Project 22209).

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1. Introduction

Technology is rapidly changing the retail sector. The retail industry is extremely competitive with a constant pressure to provide the right range of products and services at the right location - physical or virtual - for the right price (Reynolds and Cuthbertson 2014). In order to succeed in this highly competitive context, retailers need to constantly innovate to stay up-to-date with the fast-changing consumer demand and environment. They need to complement their business models with intelligent technologies, not only to enhance and personalize the customer experience, but also to optimize their operations (Roy et al. 2017, 257).

2. The Food Retail Industry

2.1. Definition

As stated in the European industry classification system (NACE) (2008), commerce can be defined as the act of trading products and services in exchange of money, and is usually consider the basis on which economies are built. The commerce value chain includes numerous organizations, activities, functions and institutions that are responsible for trading goods and services from the initial production stage to the end consumer (Reynolds and Cuthbertson 2014).

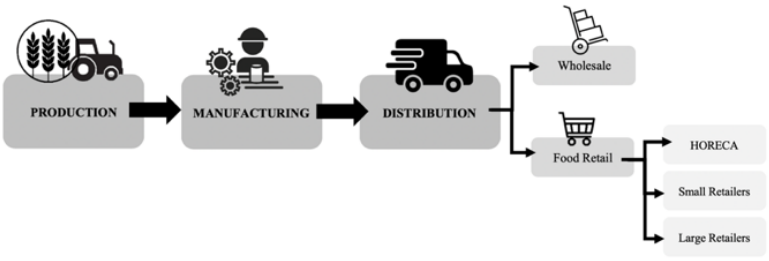

Figure I: Stages of the food retail value chain. Source: Author based on *Autoridade da Concorrência* (2010).

The Organisation for Economic Cooperation and Development (OECD) (2020) defines retailing in the International Standard Industrial Classification (ISIC) as "the re-sale (sale without transformation) of new and used goods to the general public, for personal or household consumption or utilization". It can be generically distinguished in brick-and-mortar (in physical locations like stores or boutiques) and online sale (Weber and Schütte 2019). According to the

Portuguese Statistics National Institute (INE) (2007), retailing can be globally separated in: **food retail** or **non-food retail.** Food retail includes the trade of packaged and unpackaged food goods, beverages (with and without alcohol), tobacco and household products. Non-food retail includes the sales of automobiles, electronic apparels, gas, clothing, furniture, hospitality and beauty products. The focus of this research will be in the food retail category which, in terms of turnover, is the most important retail category. The Competition Authority (*Autoridade da Concorrência*) (AdC) in Portugal states that food retail has three main stages across its value chain: (i) the upstream stage of **production**; (ii) the intermediate stage of **manufacturing and supply**, with companies being able (or not) to be themselves producers and (iii) the downstream activity of **distribution** (Loureiro 2014).

This research will focus in the last stage, **the food distribution**, which refers to the product acquisition from suppliers in order to resell to the final consumer (AdC 2010). Historically, two types of intermediary organizations cover this trading stage: **wholesalers** - that sell large quantities of goods to different businesses, including hotels, caterers, butchers, bakeries, fishmongers and local markets - and **retailers** - that sell small quantities for direct consumption (Reynolds and Cuthbertson 2014). Although less visible than retailers, wholesalers remain an important agent for the economy since they are the main bridge between producers and retailers. Retailers normally include the HORECA[1] channel, small retail chains and large retail groups. The aforementioned, own small mini-markets and supermarkets, as well as large public store formats such as hypermarkets, for use or consumption.

1 European abbreviation for Hotel, Restaurant, Café.

In a summary, this thesis will be studying the food retail industry, specifically the distribution stage of the value chain focusing on large retail groups. Since they comprise a set of specific characteristics, wholesalers and the HORECA and small retailers channels will not be included in this study (AdC 2010). Moreover, the focus will be the physical food retail stores. The online channel will be not be subject of study due to its specific customer approach.

2.2. Global Market Analysis

According to the report *Global Powers of Retailing 2020*, in 2018, the aggregate revenue of the 250 largest retailers attained US$ 4.74 trillion, representing a revenue growth of 4,1% year-over-year (Deloitte 2020). Although having low net profit margins, in 2018, the fast-moving consumer goods (FMCG) category registered the largest average revenue (US$ 23.187 billion), representing almost 67% of the total retail revenue (Deloitte 2020). As shown in the Appendix 1, the sector comprises almost 55% of the total number of retail companies, including the first five companies from the Top 250 worldwide. Regarding the main retail players, similarly to the previous year, the report identifies the American chains **Walmart** and **Costco** as first leaders in the ranking (Deloitte 2020). Moreover, **Amazon** pushed the retail leader **Kroger** to the fifth position and became the third-largest retailer (Appendix 2). This change may be explained by Amazon's competitive pricing strategy, strong investment in Prime Now - a 2-hour delivery service of essentials and household items - , acquisition of Whole Foods and launch of Amazon Go – a cashier-free convenience store concept (Deloitte 2020). The German group **Schwarz** - owner of *Lidl* chain - also moved up, becoming the fourth-largest retailer in 2018. In terms of geography, from the largest 250 retailers, the highest number of companies is concentrated in Europe, being the majority based in Germany, UK and France, and representing together 35% of the total retail revenue. However, seven from the ten largest retailers are established in the United States and contribute to almost 50% of the total retail revenue (Deloitte 2020).

2.3. Portuguese Competitive Landscape

According to the *Associação Portuguesa de Empresas de Distribuição* (APED), the food retail market is considered a dynamic, sustainable and important contributor to the employment and economic activity in Portugal (Félix 2012). The industry grew 3.8% in 2018 and reached a total sales volume of €20.945 million, corresponding to almost 73% of the overall market's value. Between 2017 and 2022, the expected compound annual growth rate (CAGR) is 2,9% (Wynne 2018).

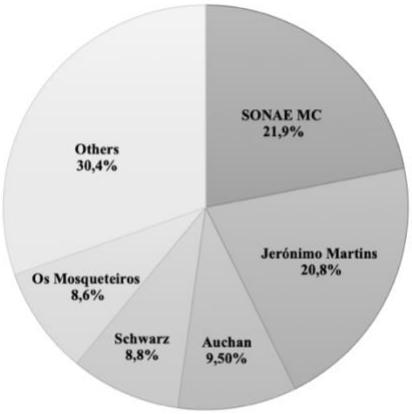

Figure II - Market shares of food retailers in Portugal.
Source: Author based on information from official companies websites and Euromonitor (2018).

As shown in Figure II, the market is mostly concentrated in **five key players** that hold almost 70% of market share. Two main retail groups lead the Portuguese preference: **SONAE MC** (hypermarkets *Continente*, supermarkets *Continente Modelo, Continente Bom Dia* and convenience stores *Meu Super*), holding 21.9% of market share, and ***Jerónimo Martins*** (hypermarkets and supermarkets *Pingo Doce* and wholesaler *Recheio*), holding 20.8% market share. As described in the report "*Global Powers of Retailing 2019*", *Jerónimo Martins* occupies the 55th place in the ranking of the 250 largest retail companies worldwide, representing a growth of 60 positions in the last ten years. At the same time, SONAE also climbed 20 positions in the global ranking, and is currently occupying the 156th place (Deloitte 2019). Following these two main players, there are three other groups: **Auchan** - hypermarkets *Jumbo* - , **Schwarz** - discounter *Lidl* - and ***Os Mosqueteiros*** - hypermarkets and supermarkets *Intermarché*. As presented in Appendix 3, at the end of the ranking are Dia - discounter *Mini Preço* -, eLeclerc and Aldi (Euromonitor 2018). It should be noted that, from the top worldwide players, Schwarz is the only group present in the Portuguese top. It is also important to refer two Spanish groups that have a slight presence in Portugal: **Mercadona**, who entered the market last year and mainly invested in the North of Portugal,

and ***El Corte Inglés*** - supermarkets *Supercor* - , usually distinguished from the players mentioned above due to its premium product offering and higher prices (Almeida 2016).

2.4. Market Trends in Portugal

After the economic recession in 2008, the Portuguese consumers' spending and confidence both registered an increase throughout the following years (INE 2019). Since then, all food retail players have been following an *Every-day-Low-Price* pricing strategy, which promotes the use of low and stable prices (Fernandes 2018). On one hand, the food retail industry in Portugal has a high volume of supermarkets and hypermarkets, mainly because of their wide variety of food and non-food products, lower prices, extended opening hours, experiences in store and promotions. Regarding the market players, ***Continente*** leads the hypermarket channel and ***Pingo Doce*** the supermarket channel (Deloitte 2019). On the other hand, traditional stores, such as small neighbourhood grocery stores, have been losing market share, due to their higher prices and lower assortment of products. Overall, Portugal continues to place significantly above the European average of 7 800 stores with around 20 300 traditional stores spread across the territory (APED 2018). However, data shows that the number of hypermarkets has recently began to decrease. The emergence of specialized food stores and *discounters* – stores that sell a wide assortment of products with a primary focus on price, like Lidl or Aldi, – led to an increase of supermarkets (APED 2018).

With the beginning of a new decade, the Portuguese food retail industry is faced with new opportunities and challenges. According to the *Confederação Empresarial de Portugal* (CIP), **demographic changes**, **technologic disruption**, **climate change** and the entry of **new players** are some of the challenges that food retailers will have to face in the upcoming years which will radically change the consumption patterns in Portugal. Additionally, Portuguese consumers increasingly search for convenience, personalized experiences and sustainable alternatives. They are also more vulnerable to trends and less loyal to brands (CIP 2018).

According to the report "*The Future of the Commerce Sector in Portugal*" (CIP 2018), from a demographic point of view, the key challenges are the progressive aging of the Portuguese population and the increasing demographic of Millennials and Generation Y. Besides that, there is an increase of the family disintegration phenomenon, which means that each individual inside a "home" now represents an individual consumer, with specific needs, choices and purchases. Secondly, technologic disruption is forcing retailers to reinvent their business model every day. Nowadays, companies should be able to provide an omnichannel, convenient and integrated customer experience, including a good synergy between the online and physical dimensions of stores. Retailers who are unwilling to innovate and are not prepared to include new technologies in their value chain, largely risk failing (CIP 2018). Moreover, consumers' awareness of the ecological footprint is augmenting and the demand for environmentally responsible products is increasingly evolving (CIP 2018). Consequently, retailers have to be more creative to respond to these needs, by providing more recycled products and adopting sustainable shopping experiences.

Finally, the entry of new players is also *waking up* food retail players in Portugal. Last year, Mercadona, the Spanish leader which ranked 41st in the Top 250 World Retailing Companies, invested €25 million in the opening of four stores in the northern Portuguese region (Wynne 2018). Furthermore, Amazon's exponential international expansion is also becoming a real threat for retailers in Portugal. Amazon Fresh and Amazon Go are still not present in Portugal's food retail industry, but retail specialists say this may be coming soon. Given its digital competitive nature, Amazon not only has the capacity to break paradigms and innovate constantly, but also to reach consumers without the need to open physical stores (Fernandes 2018). For that reason, its eventual entry in the Portuguese market can seriously affect the business of the current established players (Pacheco 2018).

3. Artificial Intelligence at a glimpse

3.1. Technology: from driver to enabler

Some years ago, companies kept and shared information in papers and physical documents. Business data was strictly analogue. During the 1980's, computers became more affordable and common, and many organizations started to convert their handwritten records into digital files. The process of transforming analogue information into digital is named **digitization**. In the following years, digital data evolved exponentially and businesses started using it to improve work efficiency, creating a new process: **digitalization** (Salesforce 2018). As digital technology evolved, companies began to generate ideas of doing business in new ways - the notion of digital transformation started to gain shape.

Digital transformation can be explained as "the process of using digital technologies to create new — or modify existing — business processes, culture, and customer experiences to meet changing business and market requirements" (Salesforce 2018). According to the World Economic Forum (WEF) (2016), digital transformation is transforming whole businesses and industries and redefining the society. This technological progress enables more accurate decision-making, improves efficiencies and reshapes customer experiences by increasing the expectations regarding personalization, accessibility and convenience. Moreover, with digital transformation, industries are provided with unique opportunities to create and capture value. According to the report "*Digital Transformation of Industries*" (WEF, 2016), Fortune 500 companies used to take two decades to reach a billion-dollar valuation. Nowadays, tech-based startups are getting to this value in less than five years. However, the pace at which each industry is changing is different. These differences are due to the unequal levels of maturity of digital disruption in industries, and the pace at which technology is being implemented.

In general, technology refers to the new machinery and equipment that were developed using scientific knowledge to convert resources into outputs for practical purposes in industry and

businesses (Cambridge 2017). In the past ten years, technology shifted from being a driver, to be a **fundamental enabler of innovation**: it not only helps develop new digitally-driven economic and business models, but also to create value to sustain inclusive economies (OECD 2017). The Fourth Industrial Revolution drove transformational disruption across almost all sectors. Industries and business models assisted to the appearance of innovative products and services, changes in costs and reduced obstacles to the entry of new competitors. Companies were forced to re-think their creation and capture of value, and to connect machines, sensors and IT systems to their value chain (WEF 2019). The World Economic Forum (2020) stated that, over this decade, more than 60% of the value created in the economy will come from digitally enabled business activities. Following that, there are five technologies that will mainly transform industries and economies in the next decade: Blockchain, Digital Currencies, Artificial Intelligence, 5G Network and Quantum Computing (Comm 2018). Together, they will not only create new opportunities for the industry, but also contribute to build a whole new society. However, industries and governments still need to tackle several challenges like, for example, cultural transformations, regulation update and talent and skills gaps (Jabil 2019).

3.2. Definition

For the purpose of this research, we will focus and explore in depth one of the five technologies that are radically shaping industries: **Artificial Intelligence** (AI). Considered "the backbone of digital transformation", this is the area of Computer Science that is helping businesses to curate their products and services, automate processes and deepen their engagement with their customers (Microsoft 2018). Although today the term "Artificial Intelligence" is frequently used in the academic and corporate environment, because it is a multidisciplinary and complex subject, a universally accepted definition is still lacking. The term was firstly used by John McCarthya, a Standford University professor and computer scientist, who is generally accepted as the "father" of AI (Peart 2017). He not only coined it as an academic discipline but also

defined it as "*the science of making intelligent machines*" (Peart 2017). According to the Massachusetts Institute of Technology (MIT) Technology Review, AI is a vast term associated to machines that, similarly to humans and animals, make logical reasonings, learn, operate and take their own decisions (Hao 2018). It does not refer to one single technology but to an umbrella of different technologies, interconnected and based on each other, including Predictive Analytics, Machine and Deep Learning, Natural Processing Language, among others (Appendix 4) (Zapke 2019).

3.3. Adoption of AI in the Industry

Globally, the investment in Artificial Intelligence is growing fast. In 2016, companies from all sectors worldwide invested between $26 billion and $39 billion in AI, from which $20 billion to $30 billion were spent by tech giants (Bughin et al. 2017). However, setting aside the tech industry, the use of AI is still in a testing and premature phase. According to a McKinsey Global Institute (MGI) survey (2017), from the 3.000 executive respondents, from more than ten industries and countries, merely 20% referred the current use of AI in their business activity. Moreover, many of them expressed uncertainty regarding the return on investment made. The same survey revealed that, across all sectors, larger industries and companies - with more than 500 employees - that adopted other technologies in former times, are more predisposed to use Artificial Intelligence nowadays (Bughin et al. 2017).

As showed in Figure III, the leading sectors are the high tech, telecommunications and financial sectors. These have been leading industries in the adoption and development of technologies, both for product improvement or operational optimization. The automotive sector is well-positioned as well regarding AI adoption due to its large investment in advanced robotics and

in the development of self-driving cars. The figure also shows a middle area with less digitalized industries such as resources and utilities, retail, media and entertainment, and construction. These are sectors where, for the majority of companies, the adoption of digital tools, namely AI, is slower. Finally, the education and health care sectors are clearly the slowest AI adopters, probably because of particular challenges such as regulatory concerns and customer acceptance (Bughin et al. 2017). In terms of functions, according to the same MGI survey, generally, companies find AI technologies useful throughout the whole value chain. However, they are more willing to implement AI-based technologies in customer-oriented roles - sales or marketing - product development, and more reticent in financial management roles.

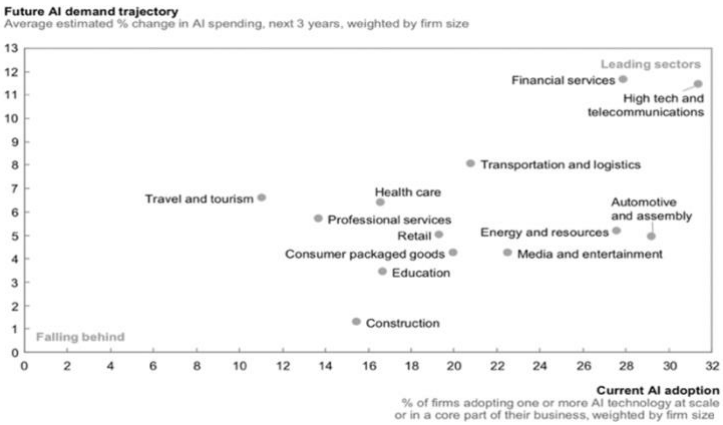

Figure III - Sectors leading in AI adoption today globally.
Source: McKinsey Global Institute , 2017

3.4. AI Applications in Food Retail

When it comes to the retail industry, AI is transforming every aspect of the retail spectrum, from automated shelf replenishment to personalized shopping experiences (NRF 2019). According to the International Data Corporation (IDC) (2018), last year, this industry had a leading global annual spending on AI of $5.9 billion, by heavily investing in solutions such as shopping advisers, automated customer service agents and product recommendation platforms. By 2022, globally, retailers will spend more than $7.3 billion on AI (Capgemini 2019). Moreover, a report launched by IBM (2019), which surveyed 1 900 retail and consumer goods companies across 23 countries, said that 85% of retailers worldwide plan to implement AI in their supply chain by the year 2021 and that they believe this introduction will lead to a 10 percent annual growth for their companies. According to the report "*Technology Vision 2017*

for Consumer Goods" (Accenture 2017), retailers can benefit from AI in two major ways: **Customer Experience** and **Operations Optimization**.

Firstly, there is a growing use of AI to reshape customer experience and customer service in food retail businesses. Almost 80% of the inquired decision makers said that the collection of information, insights about consumer behaviour and purchase decisions, will be revolutionized by AI (Accenture 2017). Tracking and responding to fast-shifting customer sentiment as well as establishing and maintaining a direct relationship with customers is more important than ever. For instance, AI interfaces are being used in retail to recognize and interpret shoppers facial, biometric and audio data to identify **in-the-moment emotions** and reactions in order to deliver the appropriate products, support and recommendations. According to the Biometric Marketing 2019 report (eMarketer 2019), AI is using biometric technology to track shoppers in brick-and-mortar stores, learn their preferences and use the information collected to interact with them via their phones and in-store signage. One example is the American grocery chain Kroger which is using a AI-based signage solution called Enhanced Display for Grocery Environment (EDGE) to analyse data generated by shoppers reactions and actions on and around shelves (Microsoft 2018). If a customer has the Kroger app open, when walking through a store aisle, sensors will identify the shopper and will recommend products that might be interesting for them. For example, by connecting sensors with the customer's smartphone, the app can automatically identify a gluten-free consumer and enhance gluten-free snacks, or suggest child friendly products to a customer identified as a parent (Morgan, 2019). It can also provide notifications about discounts and offers if it detects that a product of the desired buying list is in promotion. Additionally, retailers can now customize and **personalize stores layouts** by adapting in-store product and pricing displays to maximize customer satisfaction (Terblanche and Boshoff 2004). All of these options can reshape the in-store customer experience.

Secondly, retailers are making use of AI in physical stores to support and **optimize inventory** management, **automate repetitive processes** and **prevent theft.** Regarding inventory management, an interesting development in groceries is the use of robotics with AI-driven notifications that provide information about which products will need to be restocked and when (Weber and Schütte 2019). This is possible because demand forecasting is permanently updated with in-store real-time data. As a result, grocery retailers can now avoid stock-outs, reduce waste and have greater profitability. Besides that, retailers are also using **smart shelves**, which are wireless connected shelves that automatically keep track of the inventory in-store, by controlling the number of products through weight systems and Radio-frequency Identification (RFID) tags and scanners. If an item is depleted from the store shelf, a signal is sent to the warehouse for immediate replenishment. Smart shelves also inform staff if a product that should be stored under specific conditions - like meat or ice cream - fell on the floor, making the product control more efficient and automated (Roy et al. 2016). The replenishment can then be made by human staff or machines. A start-up called Tally, developed an AI-driven robot that travels through the grocery store, scans the shelves and automatically looks for unoccupied places and goods that are wrongly stored (Vanian 2018). Walmart, one of the largest global retail stores, is also using shelf-scanning robots to patrol store aisles in dozens of its stores. Robots identify products that disappeared or need replacement, or price labels that need to be updated, and, consequently, liberate employees for customer interactions (Heater 2019).

On the other hand, AI is helping retailers transform traditional stores into **cashier-free stores**. The robotization of stores helps reduce waiting lines, lower the number of store staff doing repetitive tasks and saves significant operational expenses (Fatyhov 2019). With the help of in-store cameras, AI, smart-shelf sensors and mobile apps, customers can enter the store, do their shopping and leave, without needing to go to a cashier (Morgan, 2019). An example are the eighteen checkout-free Amazon Go stores already opened in the United States. When entering

the store, customers are required to scan the app to begin their shopping experience. The cameras, shelves sensors and AI algorithms installed control what is taken off the shelves, and automatically add items to the customer' digital bag. When customers exit the store, the purchase amount is directly deducted from the credit card associated with their Amazon account (Amazon 2020). These revolutionary shops driven by AI help retailers not only to create a seamless shopping experience for customers, but also to reduce the number of staff doing repetitive tasks such as cashiers jobs or restocking. In automated grocery stores like Amazon Go, only six to twenty human workers are needed for high-priority tasks that require human attention, such as giving support to customers or inventory replenishment (Bandoim 2019).

Security and theft prevention are also major issues for retailers. Stores always had losses associated to fraudulent customers or cashiers that manipulate barcodes and scanners (Weber and Schütte 2019). The National Retail Federation (NRF) stated that, in the US, in 2017, robbery and fraud led retailers to a revenue loss of 1%, almost $47 billion (NRF 2019). Since 2017, Walmart invested around $500 million in a vigilance system that uses AI and Computer Vision to detect theft, manipulations and robbery. The program is already implemented in 1.000 stores and uses innovative video cameras with AI-based algorithms to track and analyse abnormal activity in self-checkout and manned cashiers (Peterson 2019). For example, every time that a product passes the exit store scanner without having been scanned before, a real-time warning is sent to the store security so that he can immediately intervene (Peterson 2019). Another major area of implementation of AI in grocery stores is in fraud detection systems for credit card payment (Weber and Schütte 2019).

4. Methodology

4.1. Research Objectives

The purpose of this study is to provide a deeper understanding on the current knowledge, adoption and use of technology, particularly AI, by some of the main food retailers in Portugal. The research aims to explore for which core retailing functions technology and AI is being used in their companies and stores. The knowledge created can be practically useful for retailers and their suppliers to learn about the topic, discover new approaches pursued by competitors or complement any technology-related strategy. The research can also be useful for students and anyone in Academia, who wants to gain a deeper understanding of the food retail sector and its future technological path. Overall, the following research questions guided the study: (1) Is technology an enabler of food retailing business? ; (2) What is AI for food retailers and are they already adopting it?; (3) What is the priority regarding the adoption of AI: customer experience or operations optimization?

4.2. Data Sources

In order to respond to the proposed questions, a qualitative research methodology was pursued. The methodology selection can be justified by the exploratory nature of the questions, which made impossible to arrive to quantitative conclusions and to "*one single version of the truth*". Instead, the study aims to provide meaningful insights regarding the Portuguese context, based on the knowledge and inputs given by industry experts.

During the first stage of the investigation, a theoretical and market research was conducted, using scientific articles, published thesis, official retailers' reports and websites, major consultancy organizations' publications and online databases (eg. Euromonitor, PORDATA and INE). In a second stage, four phone call interviews were conducted with experts in innovation and technology of four well-established food retail groups in Portugal: SONAE, *Jerónimo Martins*, Auchan Retail and *El Corte Inglés*. Based on the initial theoretical research

conducted and the opinion of some retail specialists, it was also considered relevant to interview an expert from Amazon, due to the increasing probability of the company penetrating the Portuguese retail market with Amazon Prime, Amazon Go and Amazon Fresh. It is relevant to note that the interviewed players represent different market segments and audiences: from premium to low-price focused. The number of interviews was conditioned by some external limitations, described in the corresponding section of this study. The primary data resulting from these five interviews helped gain different perspectives from experts that work with technology directly in the industry studied. In terms of profile, the majority of the interviewees (4/5) were male and had an average age of 45 years. Regarding academic education, three had a background in Management or Economics and two in Engineering. Two had a Master of Business Administration (MBA). All the experts had a retail industry work experience between six to twenty years. The majority have functions in their companies related to innovation and technology, namely IT Director, Innovation Director or Head of Digital. These roles were typically associated with the responsibilities of pursuing digital transformation processes and adopting new technologies across the business. The interviews followed a structured guide, based on a predefined set of eleven open-ended questions. Those were divided in three parts: a) general context of the technology use (5 questions); b) general context of the AI use (3 questions); c) use and functions of Artificial Intelligence (3 questions).

5. Results Analysis and Main Conclusions

5.1. Is technology an enabler of food retailing business?

The objective of the first research question was to understand what major changes happened in the food retail sector in the last decade, and if retailers perceive technology as an enabler of the future of their businesses – meaning that, if they perceive technology as a facility that enables the company to maintain its competitive advantage. Moreover, the questions in this first part of the interviews aimed to demonstrate how retailers envision the way Portuguese population will

conduct their food shopping in the next ten years, what will change in the in-store experience and what are the current priorities for companies regarding innovation.

Conclusion 1: Consumers are more informed and shop differently in terms of channels, products and duration.

Regarding the major changes that occurred in the sector in the last decade, the experts identified as the most important changes to be the growth of the **online channel** (e-commerce) and the rise of **new consumption patterns**, namely the consumption of more ready-made food and more biologic, healthy and vegetarian products. However, they highlighted that regarding the use of e-commerce for food shopping, Portugal is still behind in comparison to other European countries. Another important factor identified within the sector is the shift in **shopping duration**. Unlike before, consumers now have less time to shop and won't go to supermarkets and hypermarkets for a mere distraction. From the five experts interviewed, two also referred the increasing demand for **convenience** and **new store formats**. Actually, consumers prefer to do their grocery shop in smaller stores, closer to their neighbourhood and they increasingly try to avoid large areas such as hypermarkets. Another change pointed out was the fact that consumers now feel that **"*they have the power*"** – they can decide what, where and when to buy products. They are more informed and increasingly do a prior research before their in-store purchase. Although with less significance, other changes were also mentioned such as **globalization** – in the past consumers didn't have access to everything they wanted but today products are global - , the **narrowing of brands** – there are fewer brands and increasingly private labels are becoming a reference and start to have their own market space – and the **different geographical needs** – the store requirements are different in the North and South of Portugal. The rise of new technologies was not mentioned in this part of the interviews.

Conclusion 2: Technology is and will continue to be a fundamental enabler of food retailing.

During the discussion of the first research question, all the interviewees agreed that technology is already a **fundamental enabler** of their business activity and that it will continue to be in the near future. Furthermore, all of them said that they are already using technology in their companies and stores. "*Technology is definitely shaping the food retail sector and its importance will continue to grow*" stated one expert. The majority said that, in their companies, technology is used in two main ways: to improve **customer experience** in-store and to automate **back-office operations**. In the first case, hardware and software is used to develop applications that allow the customer to have real-time information about the products before and during the purchase. Moreover they use technology to offer an in-store experience that saves customer's time, where they can make a purchase without having to wait in a line (self-scan and cashier-free stores). Regarding the back-office use, technology is used to store data, forecasting, manage inventory in-store, and evaluate the customer reaction inside the store. In conclusion, in this case, technology serves to automate processes and gain efficiency, allowing employees to have more time to serve customers inside the store. Only one expert referred the use of technology for **security** purposes, namely to control the entrances in the stores and prevent theft and fraud. The same expert also referred that technology is being used to address **sustainability** topics such as food waste and minimize the use of plastic.

Conclusion 3: In physical stores, technology will be used to save time and stimulate the five senses. Refuelling purchases will be done online and considered a commodity.

When asked about how they foresee the food retail sector in ten years and how the Portuguese population will conduct their food shop, the experts were unanimous in one main conclusion: the online and physical channels will coexist and complement each other. In different ways, all the interviewees concluded that physical stores will not disappear but will instead make use of technology to privilege and stimulate the intelligence of the five senses. Physical stores will

continue to have an crucial role in the purchase of fresh goods, by having a selected offering and by providing differentiated store experiences – for example, having Chefs cooking inside the store or having dedicated employees to give counselling about which products to buy for a specific recipe or occasion. Furthermore, the Portuguese population will increasingly use online channels for ***refuelling purchases*** - more ordinary purchases, namely non-perishable foods or hygiene and cleaning products. They will adopt a **"subscription model"** approach: monthly schedule an online purchase with what they know they will necessarily need, and receive it at home. The customer will take for granted those purchases, as if they were a commodity (like energy or gas). It is important to refer that the majority of the experts said that the context of the pandemic crisis Covid-19 is already changing the state of the business and the consumption habits of the Portuguese population. The online consumption is growing for the purchase of non-fresh goods because it allows customers to spend less time inside the supermarkets and hypermarkets. Moreover, the majority cited that the technological transformation will continue and that there will be massification of "*Scan and Go*" - like Amazon Go - and "*Self-Scan*" systems. Technology will allow customers to save time in the purchase journey and to reduce the cash space. The experience in the physical store will go focus on customer autonomy and will favor self-payment. One of the interviewees affirmed that "*Information and technology will be the keys. The players who will not be able to keep up with this transformation, will fall*". Experts also pointed the continuous importance of having take-away and ready-to eat food in the stores and partnerships with home delivery services – such as Uber Eats or *Glovo*.

Conclusion 4: Supermarkets and small stores are the perfect locations to awake a customer journey of discovery and personalization, empowered by technology.

All the interviewees were aligned: the hypermarket format will no longer be relevant. "*I think hypermarkets are dead"* stated one of them. Consumers will value hypermarkets less as the

wide variety of products becomes less attractive. Instead, they will prefer to shop in closer proximity, in a store with an adequate size, with the sufficient variety that interests them and that is chosen for them - also known as proximity and convenience stores. That said, the food retail store of the **future is hybrid**: a mix of something virtual with something physical, which heavily combine technology and human interaction. It will be the perfect balance between repetitive shopping - facilitating the purchase of fresh products - and discovery - by taking the customer not to be confined to buy the same things. Stores will awake a customer journey of discoverability with 100% of personalization inherent. This will be empowered by technology, and will allow retailers to tailor the store offering by using the improved knowledge on customer needs and preferences.

Conclusion 5: Technology as the innovation priority for 2021.

When asked about the main priorities regarding innovation for 2021, all the retailers mentioned somehow technology. The majority stated that their companies' innovation teams are mainly focused in implementing technologies that have a transformational impact, either in consumer life or in company processes. Some examples of technologies mentioned were: Machine Learning - to automate algorithms and automate inventory processes - and Artificial Intelligence- to improve communication personalization with the customer inside the stores. Hiding technology from the consumer's eye inside the stores is also consider a challenge that has become a priority to be solved.

5.2. What is AI for food retailers and are they already adopting it?

The objective of the second research question was to understand food retailers perspective of AI, if they are already using and implementing it and how they position their companies regarding it.

Conclusion 6: Retailers see AI as a set of intelligent technologies that can learn and predict but still not capable to take decisions autonomously.

As mentioned previously in the literature review, "Artificial Intelligence" is a wide term with no universal definition, and all the experts agreed with it, " *AI has a broad definition for many things inside*" stated one of them. However, the five interviewees showed confidence while trying to define the concept and all of them gave an answer that was close from the definition considered for this research. Similarly to John McCarthya, who described it as "*the science of making intelligent machines*", the majority of the experts coined AI as a set of computer systems that manifest intelligent behaviours, which are normally associate with humans. They related AI with a combination of statistics and computer programming that use information and data to make predictions and feed decision-making models - "*AI is able to use the information that I have, the decisions I have made, and the respective consequences, to make a prediction of what will happen.*" Nevertheless, all of them positively referred the adaptive intelligence - meaning that as they receive data, they adapt and improve decisions - of these machines, but also mentioned the remaining importance of having **human intervention** to update the data, give context and take the final business decisions. In summary, AI is mostly associated by food retailers with technologies that learn and predict, namely Machine Learning and Deep Learning, but it is still not seen as a tool able to take decisions autonomously.

Conclusion 7: The use and development of AI is considered to be in an initial stage for the majority of the food retail companies.

During the interviews, the business decision makers were asked to position their company in a framework that aimed to reflect the maturity of their companies with regards to Artificial Intelligence. As illustrated in Figure IV, the framework has four quadrants, each of them representing a maturity level with regard to the number of AI-related applications currently used by the company (Y axis) and to the number of AI-related applications in a

testing/development stage (X axis). The conclusion was straightforward: the majority of the experts positioned their companies in the "***AI Beginner***" quadrant, which reveal a low number of AI-related applications are already being used and tested/developed by the company. Two experts referred that there are already some applications of Artificial Intelligence implemented in their company – namely in their customer loyalty mobile app, store communication panels and inventory predictions - but both recognized that there is still no dissemination of AI across the core activities of the organization. The opinion was unanimous: the goal is always to achieve an *AI Leader* position in the future. They consider that AI can be a truly differentiating factor in the sector, meaning that, as one of them said, "*whoever does this well, will have a large competitive advantage*".

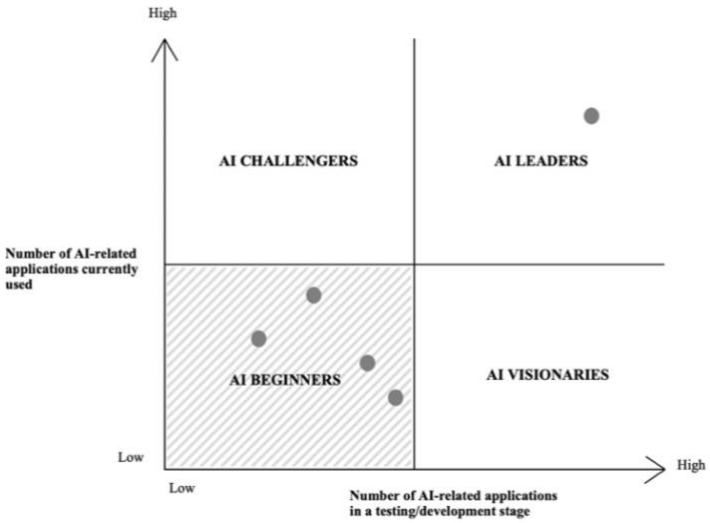

Figure IV – AI in Portuguese Food Retail Framework. Source: Author based on data collected during interviews.

<u>Conclusion 8: It is not only about technical implementation, but also to an organizational and cultural change.</u>

The answers to the previous question opened the window to a new doubt: why are retailers still at an initial stage in AI adoption? The fact was similarly justified by 3/5 of the experts: the major challenge is still related to an organizational and **cultural change barrier**. In order to adopt new emerging technologies, such as AI, organizations need to embrace change and try to close the existing skill gap within their workforce. "*If we want things with AI, we need people with other skills*" stated one of the experts. Since food retail is one of the sectors that uses the most workforce in the world, the organizational change behind the AI technical implementation

and adoption is fundamental. "*One of the great obstacles is to communicate to our people that machines are not perfect, and that they will be wrong, less than people, but they will. It is urgent to recruit talent with the adequate skills to understand and correct those errors."* Moreover, it can be tempting for organizations to think that only their own AI-based insights are correct. This cultural change is needed in order to remain vigilant to the competitive context and to the customer rapidly changing needs.

5.3. What is the priority regarding the adoption of AI: customer experience or operations optimization?

Finally, the goal of the third research question was to know which of the two core functions of food retailing is considered as the first priority in the adoption and use of AI by the company.

Conclusion 9: Operations optimization as the first priority in the adoption of AI.

All the experts agreed with the report "*Technology Vision 2017 for Consumer Goods*" (Accenture, 2017) which states that food retailers can benefit from AI in two major ways: customer experience and operations optimization. When asked about which of these was their priority, the majority of the interviewees considered the **optimization of the operations** as the most important. They added that AI should be firstly used to provide more efficiency to the operations, namely to optimize the shelves fulfilment, empower the use of cashier-free stores and facilitate the interaction of customers with mobile apps inside the store. "*Operational efficiency is what brings the best customer experience. The WOW effect is provided by the simplicity of the operations.*" said one of them. This means that, for the majority of the food retailers operating in Portugal, a good customer experience depends on the simple use of technology inside the store which is strongly dependent on the speed and efficiency of back-office operations. However, the small portion of experts that referred customer experience as their first priority, did so because they were profoundly convinced that operations in food

retailing were already very efficient and, therefore, the focus of AI should be to provide a more personalized and emotionally connected in-store experience.

6. Limitations

Even though the qualitative research method seem to be the adequate approach to this study, the answers were retrieved from a small sample and, therefore, cannot be considered statistically representative. The unexpected nationwide lockdown related to the spread of the pandemic Coronavirus (Covid-19) strongly affected the field work of this research, namely with regard to the number of interviews pursued and to the presential store observation work initially planned. In order to respond to the COVID-19 crisis, food retailers had to quickly adapt and execute contingency plans in their stores to, not only keep their operations, but also to protect their employees and staff. Therefore, and as it is completely understandable, many interviews were cancelled or denied, generating a limitation in terms of collected data for the investigation. Finally, as the qualitative data retrieved is based on individual opinions, it cannot be considered entirely objective and do not represent the global point of view of companies.

7. Future Research

Following the findings from this research, it would be relevant to conduct a study that would deeply investigate the AI technologies that are being used and tested by retailers, and make an international comparison. It would also be of considerable value to understand if and how the use of AI affect the extent to which consumers want to go to the food retail stores. Moreover, it would be interesting to investigate to what extent Covid-19 accelerated or destroyed some technologic projects, and if retailers are now considering to prioritize the use of AI for the online channel. Finally, an in depth oriented study into the challenges of organizational and cultural changes would provide valuable practical insights that could be actioned to unlock the adoption of AI in retail companies.

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A Work Project, presented as part of the requirements for the Award of a Master Degree in Management from the NOVA – School of Business and Economics.

9. Appendices

JOANA TEIXEIRA DE OLIVEIRA - 30474

A Project carried out on the Master in Management Program, under the supervision of:

Professor João Castro

22-05-2020

Table of Contents

Appendix 1: Analysis of financial performance of the retail sectors in FY2018

	Number of companies	Average Retail Revenue (US$M)	Share of Top 250 companies	Share of Top 250 revenue
Top 250	**250**	**18,976**	**100%**	**100%**
Apparel and accessories	39	11,823	15.6%	9.7%
Fast-moving consumer goods	136	23,187	54.4%	66.5%
Hardlines and leisure goods	54	16,627	21.6%	18.9%
Diversified	21	11,028	8.4%	4.9%

Source: Deloitte Touche Tohmatsu. Global Powers of Retailing 2020.

Appendix 2: Top 10 retailers in FY2018

Top 250 Rank	Change in rank	Name of Company	Country of origin	FY2018 Retail revenue (US$M)	FY2018 Retail revenue growth
1	–	Walmart Stores	US	514,405	2.8%
2	–	Costco	US	141,576	9.7%
3	▲ +1	Amazon.com	US	140,211	18.2%
4	▲ +1	Schwarz Group	Germany	121,581	7.6%
5	▼ -2	The Kroger Co.	US	117,527	-1.2%
6	▲ +1	Walgreens Boots Alliance, Inc.	US	110,673	11.7%
7	▼ -1	The Home Depot	US	108,203	7.2%
8	–	Aldi	Germany	106,175	3.2%
9	–	CVS Health Corporation	US	83,989	5.8%
10	–	Tesco	UK	82,799	11.3%
Top 10				**1527,139**	**6.3%%**
Top 250				**4,744,012**	**4.1%**
Top 10 share of Top 250 retail revenue				**32.2%**	

Source: Deloitte Touche Tohmatsu. Global Powers of Retailing 2020.

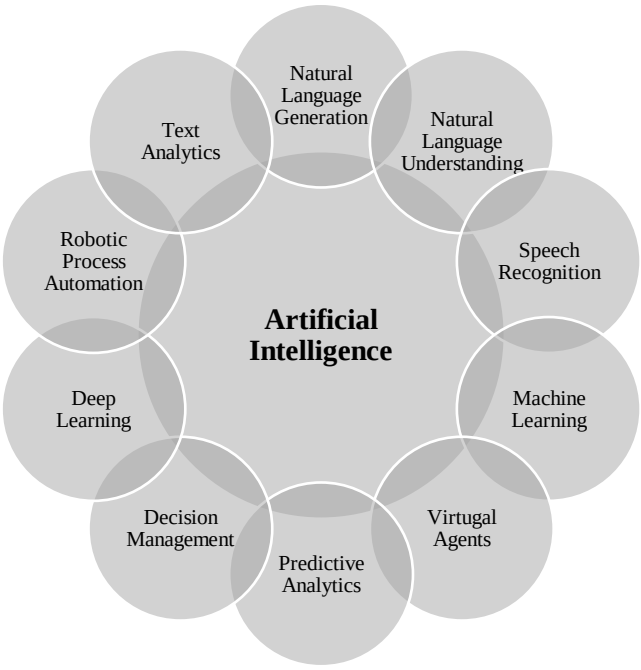
Appendix 3: Food retail players in Portugal

Ranking	Group Name	Brands	Store Format	Market Share (%)	Nº of Stores*
1	SONAE MC	*Continente, Continente Bom Dia, Continente Modelo, Meu Super*	Hypermarket, Supermarket and Convenience Store	21,9	564
2	Jerónimo Martins	*Pingo Doce, Recheio*	Hypermarket, Supermarket and Convenience Store	20,8	441
3	Auchan	*Jumbo*	Hypermarket and Supermarket	9,5	95
4	Schwarz	*Lidl*	Supermarket	8,8	256
5	Os Mosqueteiros	*Intermarché*	Supermarket and Convenience Store	8,6	240
6	Dia	*Mini Preço*	Convenience Store	4,1	600
7	E.Leclerc	*E.Leclerc*	Supermarket	2,5	21
8	Aldi	*Aldi*	Convenience Store	1,1	70

Source: Author based on Euromonitor and official companies websites.

* Based on information from March 2018.

Appendix 4: Artificial Intelligence Branches



Source: Author based on Press, Gil. (2017).